

Achieving Zero-Net Energy Affordable Multifamily Homes

PIER Buildings Program

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The Issue

In 2008 the state of California set bold energy-use reduction goals, targeting zero-net energy (ZNE) use in all new homes by 2020. Currently, there are relatively few examples that showcase the technical and market feasibility of affordable ZNE multifamily housing developments. To meet California's bold goals, much work will be needed during the next nine years to gather and synthesize information about the essential planning, elements, conditions, and tools that are necessary to create successful multifamily ZNE projects.

The Solution

In 2004, the California Energy Commission's Public Interest Energy Research (PIER) program solicited proposals for new ZNE projects and awarded funding to Global Green USA to help develop two affordable multifamily ZNE projects. The first project, Solara, developed by Community Housing Works and focused primarily on electricity generation, opened in 2007 in Poway, California. The second project, Los Vecinos, developed by Wakeland Housing and focused primarily on energy efficiency, opened in 2009 in Chula Vista, California (**Figure 1**).

Both projects cut electricity costs for occupants by more than 60 percent on average. However, researchers found that the ability to achieve ZNE in any particular dwelling unit is highly correlated with tenant operational behavior. To realize ZNE performance in an individual unit, the tenants in the unit have to adopt energy-efficiency practices around how they choose and operate purchased appliances and electronic devices.

Specific to the Los Vecinos complex, one unexpected finding revealed a conflict between the building height and the availability of space for solar photovoltaic (PV) installations. Local fire-fighting protocols require roof access for buildings three stories tall or greater, so that there was less roof space available for PV panels than originally planned.

Features and Benefits

The PIER solicitation, from which the Solara and Los Vecinos proposals received funding, requested that project developers

attempt to meet four specific goals: (1) Deliver a 70 percent annual electricity cost reduction compared to a typical new affordable housing project; (2) exceed Title 24 (2005) energy-efficiency standards by 25 percent; (3) demand no more than 1 kilowatt (kW) of peak electricity per unit; and (4) require no more than \$5,000 (after rebates and incentives) in up-front costs for efficiency and on-site generation measures.

The two ZNE developments have so far performed very near the established energy-efficiency and economic criteria. Both delivered an average of 62 percent annual electricity cost reduction to their tenants relative to other affordable housing units in the area, and tenants who adopt energy-efficient practices have seen their electricity bills almost eliminated. Both projects have also consistently maintained peak electricity demands well below the 1-kW threshold and were net exporters of electricity during the hottest months of the year.

Figure 1: Los Vecinos affordable multifamily zero-net-energy development, Chula Vista, California

This multifamily housing complex, by Wakeland Housing, incorporated photovoltaics, tankless hot-water heaters, and many other green building features such as low-volatile organic compound paints and sealants, dual-flush toilets, drip-irrigation landscaping, and recycled-content building materials. In 2009, Los Vecinos received a Leadership in Energy and Environmental Design Platinum certification and was named Multifamily Project of the Year by the U.S. Green Building Council.



Courtesy: Wakeland Housing

On a per-unit basis, Solara cost about \$2,100 more to build than a typical multifamily affordable housing project, and Los Vecinos developers spent an additional \$3,080 per unit. At Solara, most of the cost premium went to on-site electricity generation (69 percent), whereas at Los Vecinos much more of the budget was used for energy efficiency (74 percent).

Relative to 2005 Title 24 energy-efficiency standards, Solara fell short of meeting the Commission's goal, with only a 15 percent improvement over the standard, whereas Los Vecinos far exceeded the Commission's goal with a 43 percent boost in energy efficiency relative to Title 24. At both developments, overall electricity consumption was lower than expected, but large variations in annual net electric use were observed among units—despite the fact that identical appliances were installed.

As part of the effort, Global Green USA developed several tools and resources that will help developers plan and evaluate future ZNE multifamily projects. One of these tools is a solar affordable housing assessment calculator. Using this calculator, developers can vary inputs such as number and size of units and tax-credit details to evaluate multiple project design and cost scenarios. In addition, Global Green USA produced educational media documenting the two affordable multifamily ZNE projects, including two online videos. The videos provide a side-by-side comparison of two examples that show alternative approaches to how developers might plan future affordable ZNE projects.

Applications

There is significant potential for replicating the Solara and Los Vecinos projects, with roughly 10,000 new affordable housing developments being built in California annually. These projects demonstrate that multifamily ZNE developments can be financially viable for affordable housing developers, and that energy cost modeling is accurate enough to underwrite the additional debt accrued through a ZNE development.

California Codes and Standards

Developers have used 2005 Title 24 standards as a baseline for measuring energy-efficiency performance, though Title 24 standards do not include data on plug, lighting, and other residential loads. Data collected on-site from these

two ZNE projects could be useful in adding such data to the Title 24 standards and/or for creating new standards for plug-load efficiencies or ZNE building performance criteria in general.

What's Next

Global Green USA concludes that a more precise definition of “zero energy” will help support future ZNE developments. The organization also identified lighting and plug loads as two electricity end uses that require further developments in both technology and standards in order to reduce energy consumption. In addition, Global Green USA found that tenant practices represented a large area of uncertainty and a potential barrier to achieving per-unit ZNE goals. More work is needed to determine effective strategies for estimating and influencing tenant energy-use behavior.

Collaborators

Global Green USA

For More Information

For more information on this project, please contact the California Energy Commission researcher listed below. Also check the Commission's web site (www.energy.ca.gov/research) where the final report on this research will be posted.

More PIER Technical Briefs can be found at www.energy.ca.gov/research/techbriefs.html.

Global Green USA Solar Affordable Housing Assessment Calculator, www.globalgreen.org/solarcalculator.

Global Green USA educational videos, www.globalgreen.org/greenurbanism/zero.

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About PIER

This project was conducted by the California Energy Commission's Public Interest Energy Research (PIER) Program. PIER supports public interest energy research and development that helps improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

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